OPERATION REDWING — **PROJECT** 1.2

BLAST MEASUREMENTS on a MEDIUM—YIELD SURFACE BURST(U)

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Figure.1.1 Precursor chart.



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only the later measurements were considered the thermal yield would be expected to be about 15 kt. This would not change the relative likelihood of precursor formation between the 40-kt surface burst and the Greenhouse shots, but it would bring them up nearer the Nevada shots above Castle 6 which had little sign of a precursor. The curve marked L is for Shot Lacro we using measured thermal yield, and will be discussed in Chapter 3.

Figure 1.4 shows that the early measurements of thermal yield made by Naval Research Laboratory (NRL) were generally lower than later ones made by either NRL or others. It sho be noted that if only the later measurements (After Tumbler-Snapper) are considered, there i no apparent difference in thermal yield of high or low air bursts. Although the lower limit co



Figure 1.4 Thermal versus total yield.

ered by these measurements is about 100 feet scaled height of burst, this indicates that surfac bursts should not differ either, since they are similar in shape (hemispherical) to the low air bursts during the radiation of almost all the latter's thermal energy. This means that one sho not expect any appreciable reduction in thermal for surface bursts compared to air bursts as long as the yield is in the range covered by the observations, i.e., above about 10 kt. The lar reduction in the thermal yield (one third of an air burst) for the Jangle surface shot, if true, must rapidly become less when the yield increases to 10 kt.

It was evident from the above reasoning that blast measurements on Shot Lacrosse could pr vide useful information about precursor formation. The calculations presented above show that

13

TABLE 11 OVERPRESSURE RESULTS

ft sec pai pai sec pai-sec pai-sec	Blation	Ground Range	8 0	Arrival Time	Peak Positive Pressure	Peak Nogative Pressure	Positive Pressure Duration	Negative Pressure Duration	Positive Pressure Impulse	Negati Press Impul
3021 600 IGBL 0.050 340 Toecret bad after 0.058 sec 3021 690 IGBR 0.050 370 Record bad after 0.058 sec 3021 690 IGBR 0.050 370 Record bad after 0.058 sec 3021 690 IGBR 0.050 330 Record bad after 0.054 sec 3022 820 2GBL 0.102 135 1 0.48 1 11.6 3023 1,306 370 332 1.32* 1 0.48 1 11.6 1 3023 1,400 36BL 0.102 135* 1 0.51 4.5 4.8 1 1 3023 1,400 36BR 0.264 340 4.5 4.8 4.8 4.8 7 1 3023 1,400 36BR 0.264 340 4.5 4.8 4.8 7 7 7 3023 1,400 36BL 0.264 340 4.5 6.5		E		398	psi	psi	398	5 6 6	psi-sec	pei-se
3021 690 IGHR 0.650 370 Record bad after 0.054 sec 3021 690 iGBR-RF 6.050 330 Record bad after 0.054 sec 3022 920 2GBL 0.104 135 1 0.48 1 11.6 1 3023 920 2GBL 0.102 135* 1 0.48 1 11.6 1 3023 1,400 36BL 0.102 135* 64 4.5 1.6 7 1.6	3021	069	1GBL	0.050	440		Record	bed after 0.0	Se sec	
3021 690 iGBR-Rf 6.050 330 Record bad after 0.090 sec 3022 920 2GBL 0.104 155 1 6.46 1 11.6 1 3023 1 320 2GBL 0.102 132* Record bad after 0.113 sec 11.6 1 3023 1 370 0.612 132* 6.1 7 7 7 7 <td>3021</td> <td>630</td> <td>IGBR</td> <td>0.650</td> <td>370</td> <td></td> <td>Record</td> <td>bad after 0.0</td> <td>54 Bec</td> <td></td>	3021	630	IGBR	0.650	370		Record	bad after 0.0	54 Bec	
3022 920 2GBL 0.104 135 1 6.46 1 11.6 1 3023 920 2GBR 0.102 132* 1 6.46 1 11.6 1 3023 1,386 278 0.102 132* 845 4.5 4.6 1 11.6 1 3023 1,490 36BL 0.244 361 4.3 0.43 4.5 4.6 6.1 6.	3021	969	ICBR-RF	6.050	330		Record	bad after 0.0	No arect	
3022 920 2GBR 0.102 132* Record bad After 0.113 acc 3023 1,306 2P3 0.244 561 4.3 4.5 4.6 3023 1,400 3GBR 0.244 561 5.7 0.51 4.5 4.6 3023 1,400 3GBR 0.244 561 5.7 0.51 4.5 6.1 6. 3023 1,400 3GBR 0.264 561 6.5 7. 0.51 4.5 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.5 7.7 7.7 3024 1,705 061P3 0.447 33.9 4.0 0.56 4.4 4.2 6.5 7.7 3024 1,825 467B 0.465 35 3.5 6.5 6.5 7.7 3024 1,825 467B 17.1 2.1 0.56 4.4 4.5 5.0 6.5 3024 1,825 6.841 17.1 2.1 0.56 4.4 5.0 <t< td=""><td>3022</td><td>920</td><td>2GBL</td><td>0.104</td><td>155</td><td></td><td>6.48</td><td>٣</td><td>12.6</td><td>ep</td></t<>	3022	920	2GBL	0.104	155		6.48	٣	12.6	e p
3023 1,368 3P3 0.244 641 4.3 0.43 4.5 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 6.1 4.6 4.6 6.1 4.6 4.6 6.1 4.6 4.6 6.1 4.6 7.7 7	3022	920	2GBR	0.102	132*		Record	bad after 0.11	13 aec	
3023 1,400 3GBL 0.244 361 3.7 0.51 4.3 6.1 6.1 3023 1,490 3GBR 0.264 561 5.6 6.5 7.7 3023 1,490 3GBR 0.264 561 5.6 6.5 6.5 7.7 3024 1,793 001P3 0.447 33.9 4.0 0.56 4.4 4.2 6.5 3024 1,625 46RU 0.467 33.9 4.0 0.56 4.4 4.2 6.5 3024 1,825 46RU 0.4652 35 5.0 0.56 4.4 4.2 5.0 3024 1,825 46RU 0.4652 35 5.0 0.56 4.4 4.2 5.0 3024 1,825 46RU 0.465 35 5.0	3023	1,368	223	0.24	Bet	4.4	0.43	4.5	4.8	7.7
3023 1,470 3GBR 0.264 561 2.5 0.53 3.5 6.5 7 120.01 1,793 001P3 0.447 33.9 4.0 0.56 4.4 4.2 6.5 3024 1,025 4GBL 0.447 33.9 4.0 0.56 4.4 4.2 6.5 3024 1,025 4GBL 0.465 35 5.0 6.6 4.2 6.6 3024 1,025 4GBL 0.465 35 3.0 0.56 4.4 4.2 6.6 3024 1,025 4GBL 0.465 35 3.0 0.56 4.4 5.0 6. 3024 1,025 46BL 0.465 35 3.0 0.56 4.4 5.0 6. 3024 1,025 2,300 101GB 0.644 17.1 2.1 0.56 4.1 5.0 6. 3.1 3.1 3.2 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.1 3.1 3.1 3.1	3023	1,400	3GBL	0.244	381	5- 53	0.51	4 .3	6.1	6.1
120.01 1,793 001P3 0.447 33.9 4.0 0.56 4.4 4.2 6. 3024 1,625 463k1 6.4652 35 5.6 0.54 4.5 5.0 6. 3024 1,825 463k1 6.4652 35 5.6 0.54 4.5 5.0 6. 3024 1,825 463k1 6.465 35 3.0 0.54 4.5 5.0 6. 3024 1,825 463k1 17.1 2.1 0.54 4.4 5.0 6. 3021 1,825 6.841 17.1 2.1 0.64 4.3 3.3 3.3 3.3 3.3 3.3 3.1 3.1 3.1 3.1 3.3 3.4 3.4 3.4	3023	1,490	SGBR	0.264	565	5	0.53	3.5	6.5	7.4
3024 1,825 4GBL 6.452 35 5.6 0.54 4.5 5.0 6.6 3024 1,825 4GBR 6.4652 35 5.6 6.5 6.6 <	120.01	1,793	001P3	0.447	33.9	4.0	0.58	4.4	4.2	6.7
3024 1,825 4GBR 0.466 35 3.0 0.54 4.4 5.0 6 120.02 2,500 101GB 0.641 17.1 2.1 0.64 4.3 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4	3024	1,625	46BL	0.452	32	5.5	0.54	4.5	5.0	6.0
120.02 2,500 602P3 0.641 17.1 2.1 0.64 4.3 3.3 3.3 3.1 121.01 2,500 101GEB 6.842 17.6 1.6 0.80 3.9 4.1 3.3 3.3 3.3 3.3 3.3 3.1 3.1 3.2 3.2 3.3 3.1 3.1 3.1 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 <	3024	1,825	4CBR	0.465	3 2	0 6	0.54	4.4	5.0	6.6
121.01 2,500 101GB 0.842 17.6 1.6 0.80 3.9 4.1 3. 120.03 2,906 003P3 1.096 12.8 1.7 0.84 4.0 3.5 2.1 120.03 2,906 103P3 1.096 12.8 1.7 0.84 4.0 3.5 2.1 121.02 2,900 102GB 1.097 12.7 1.8 0.79 4.6 3.4 3.4 120.04 3,250 694P3 1.30 11.0 1.3 0.67 4.6 3.0	120.02	2,500	602P3	0.841	1.7.1	2.1	0.64	4.3	ణ లే	3.1
120.03 2,900 003P3 1.096 12.6 1.7 0.54 4.0 3.5 2. 121.02 2,900 10273 1.097 12.7 1.6 0.79 4.4 3.4 3.1 120.04 3,250 694P3 1.300 11.0 1.3 0.67 4.6 3.0 4.6	121.01	2,500	IOIGB	0.842	17.8	1.8	0.80	3.9	4.1	3.1
121.02 2,500 1020 B 1.097 12.7 1.6 0.79 4.4 3.4 3.1 120.04 3,250 694P3 1.330 11.0 1.3 0.67 4.6 3.0 4.	120.03	2,906	edeon	1.096	12.8	1.7	0.84	4.0	3.5	2.6
120.04 3,256 644P3 1.330 11.0 1.3 0,67 4.6 3.0 4.	121.02	2,900	102/18	1.097	12.7	1.6	0.79	4. 4	9.4 1	3.6
	120.04	3,256	044P3	1.330	11.0	1.3	0.67	4.6	3.0	4.6

* Pesk pressure at 0.110 acc, initial rise 94 pai.

f Peak pressure at 0.292 sec, precursor pressure 14.5 psi. Peak pressure at 0.292 sec, precursor pressure 19.5 psi.

i Peak pressure at 0.286 sec. 1 Not readable.

	Ground	ç	Arrival	Peak	Peak	Positive	Negative	Positive	Negative
Tours	kange	5		Pressure	Prestare	Pressure	Pressure Duration	Empulse	Pressure Impulse
	4		Bec	psi	pei	Bec	Bec	psi-sec	psi-sec
3021	202	1GBL	0.0149	442	٠	٠	٠	٠	٠
3021	202	IGBR	0.0149	312	٠	٠	٠	٠	٠
3021	202	1GBR-RF	0.0149	332	*	٠	٠	•	٠
3022	270	2GBL	0.0309	156	+	0.14	*	3.5	*
3022	270	2GBR	0.0303	133	•	٠	٠	٠	٠
3023	401	3P3	0.0725	1 8	4.3	0.13	0.13	1.4	2,3
3023	416	SCBL	0.0725	28	3.7	0.15	0.13	1.8	1.8
3023	410	SGBR	0.0784	56	2.5	0.16	0.10	1.9	2.2
120.01	525	001F3	0.133	\$	4 .0	0.17	0.13	1.3	2.0
3024	536	4GBL	0.137	*	5.5	0.16	0.13	1.5	1.6
3024	535	4GBR	0.138	35	3.0	0.16	0.13	1.5	2.0
120.02	132	002P3	0.250	17.2	2.1	0.19	9.13	1.0	0.9
121.01	132	101GB	0.250	17.9	1.6	0.23	0.12	1.2	1.1
120.03	850	003P3	0.326	12.9	1.7	0.25	0.12	1.0	0.8
121.02	850	102GB	0.326	12.8	1.8	0.23	0.13	1.0	1.1
120.04	952	064P3	0.395	11.1	1.3	0.25	0.14	0.9	1.4
* Record bu	þ								
t Not reada	ole.								

TABLE 3.3 OVERPRESSURE RESULTS SCALED TO 1 KT, SEA LEVEL

21

Sta tion	Ground Range	Gage	Arrival Time	Peak Dynamic Pressure	Dynamic Pressure Duration	Dynamic Pressure Impulse
	ft	·····	sec	psi	sec	psi-sec
3022	202	2q3	0.0309	236	0.036	3.3
3023	401	3q3	0.0725	181	0.23	2.3
120.01	526	90 1q3	0.132	22.9	0.068	0.7
120.02	732	002q3	0.250	6.6	0.20	0.28
120.0 3	850	003q3	0.326	4.0	0.27	0.25
120.02 120.0 3	732 850	0 02q3 003 q3	0.250 0.326	6.6 4.0	0.20 0.27	

TABLE 3.4 DYNAMIC PRESSURE RESULTS SCALED TO 1 KT, SEA LEVEL

TABLE 3.5 SCALING FACTORS AND AMBIENT CONDITIONS FOR SHOT LACROSSE

Ambient Pressure, Pa: 1008.5 mb	Grou
Ambient Temperature, To: 300 deg K	the
Relative Humidity: 84 percent	isla
Winds: 16 knots from 080 degrees	are
Visibility: Greater than 10 miles	dev
Tide Level: 2.2 feet above mean low	ree
water springs	was

Ground Zero: The device was fired 17 feet above the datum plane in a cab placed on a man-made island. The man-made island and Yvonne itself are about 10 feet above the datum plane. The device was 7 feet above the floor of the cab. The reef on which the man-made island was placed was 1 foot below the datum plane.

Function	Scaling Factor
Distance	$\frac{P_6}{40 \times 14.7} = 0.203$
Pressure	$\frac{14.7}{P_0} = 1.005$
Time	$\frac{T_0}{293} \frac{12}{40 \times 14.7} \frac{P_0}{13} = 0.297$
Impulae	$\frac{T_{0}}{293} \frac{12}{40} \frac{13}{P_{0}} \frac{14.7}{P_{0}} = 0.298$



Figure 3.1 Arrival time versus ground range.



Figure 3.2 Overpressure versus ground range.





Figure 3.3 Dynamic pressure versus ground range.

2

25



Figure 3.4 Impulse versus ground range.

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CONCLUSIONS and RECOMMENDATIONS

4.1 CONCLUSIONS

The measured overpressures and the dynamic pressures were in good agreement with previo measurements (References 3 and 5); that is, they corresponded to the free-air values for 1.6 times the yield of 39.5 kt. A precursor of limited extent was formed that had typical distorted wave forms and for which the dynamic pressure was abnormally high. The evidence from Castl 6, Shot Lacrosse, and Shot Zuni indicates that for surface bursts the severity of the precursor for surface bursts can depend appreciably on the ground surface condition, as well as the facto: of shock arrival time and thermal radiation incident normal to the ground. Any attempt to predict in detail requires more information not only for the PPG terrain but for other types of soil surfaces.

4.2 RECOMMENDATIONS

Information about precursor formation on surface bursts is necessary in order to decide how best to fuze and employ weapons as well as to evaluate their damage capabilities. In order to obtain this information about surfaces of practical importance an experiment over these surface or at least over a dry desert-type surface should be performed so that there will be two points to interpolate between instead of just one point from which to extrapolate.

37

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39